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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code: CH202

Course Name: PROCESS HEAT TRANSFER (CH)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two questions. Each question carries 15 marks.

1 a) Explain with examples the various modes of heat transfer? (5)

b) Develop an equation for temperature profile for a hollow cylinder with internal generation? (10)

2 a) Derive the temperature profile for unsteady state heat conduction using lumped parameter analysis? (8)

b) A metal wire of 0.01 m diameter and thermal conductivity 200 W/mK is exposed to a fluid stream with a convective coefficient 1000 W/m2K. Determine the Biot number. (3)

c) Explain transient conduction? What is the significance of Heisler chart in transient conduction? (4)

3 a) A hot fluid is being converged through a long pipe of 4cm outer diameter and is covered with 2 cm thick insulation. It is proposed to reduce the conduction heat loss to the surroundings to 1/3rd of the present rate by further covering with same insulation. Determine the additional thickness of insulation? (7)

b) Derive the expression for critical radius of insulation for a sphere? (5)

c) Differentiate between hydrodynamic and thermal boundary layer? (3)

PART B

Answer any two questions. Each question carries 15 marks

4 a) Using dimensional analysis obtain the relation Nu=f(Re,Pr).State the assumptions and conditions clearly? (8)

b) Water flowing in a steel pipe of diameter 0.02 m is to be cooled from 40°C to 30°C.The velocity of water in the steel pipe is 1.5 m/s. The inside surface temperature of the steel pipe is maintained at 25°C. The physical properties of water at mean bulk temperature of fluid are specific heat= 4.174 kJ/kg K, Density= 995 kg/m^3, Thermal conductivity= 0.623 W/m K, Viscosity= 7.65×10^{-4}Pa.s. Calculate the convective heat transfer coefficient for water. Also calculate the length of tube required. (5)

c) What are the advantages of multipass heat exchangers over single pass heat exchangers? (2)

5 a) Derive Reynolds analogy between heat and momentum transfer? (5)

b) Explain the concept of blackbody radiation? State the laws of radiation? (5)

c) Explain NTU method of heat exchanger analysis? (5)

6 a) Explain free convection flow patterns for flow across (4)
i) cold surface kept vertically
ii)cold surface kept horizontally
iii)hot surface kept horizontally

b) Two fluids exchange heat in a counter current heat exchanger. Fluid A enters at 420^oC and has a mass flow rate of 1 kg/s. Fluid B enters at 20^oC and also has a mass rate of 1 kg/s. The effectiveness of the heat exchanger is 75%.Specific heat of fluid A is 1 kJ/Kg K, and that of B is 4 kJ/Kg K. Determine the exit temperature of fluid B and the heat transfer rate. (7)

c) Explain the concept of radiation shape factor. (4)

PART C

Answer any two questions. Each question carries 20 marks.

7 a) Derive equation to determine temperature distribution and heat flux for infinitely long fin of uniform cross section. (10)

b) Saturated steam a 353K condenses on a vertical plate of 1m length which is maintained at 343K. Estimate the average heat transfer coefficient.Latent heat of vaporization of steam= 2300 kJ/kg, Properties of the condensate at film temperature of 348K are density=975 kg/m^3, Thermal conductivity=0.671W/mK, viscosity=3.80×10-4 Ns/m^2. (3)

c) Derive Nusselt equation for film type condensation? (7)

8 a) Explain the different types of feeding arrangements in multiple effect evaporators stating clearly their merits and demerits? (10)

b) Write the material and enthalpy balance of a single effect evaporator? (10)

9 a) Describe the various regimes of boiling?Also explain Zuber correlation? (8)

b) A Single effect evaporator is fed with 5000 kg/h of solution containing 1% solute by weight. The feed temperature is 303K. It is to be concentrated to a solution containing 2 % solute by weight. Evaporation is carried out at atmospheric pressure. Area of the evaporator is 69 m^2.Saturated steam is supplied at 143.3 KPa as a heating medium. Calculatethe steam economy andU. (12)
hf= 125.79 kJ/kg, H1= 2676.1 kJ/kg
Enthalpy of steam at 143.3 kPa= 2691.5 kJ/kg
Saturation temperature of steam= 383 K
Boiling point of saturation= 373K
Enthalpy of product= 419.09 kJ/kg
Enthalpy of saturation water at 383 K= 461.30 kJ/kg

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